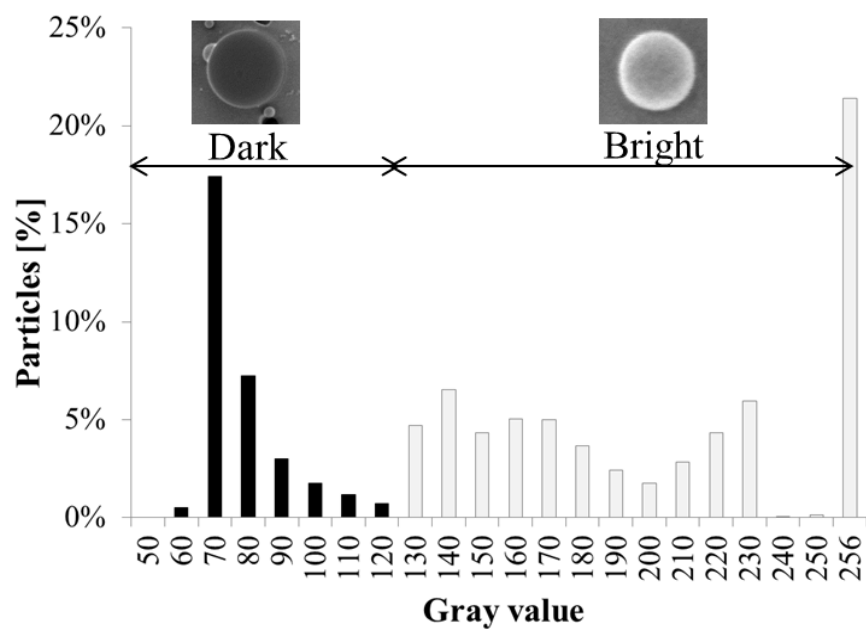
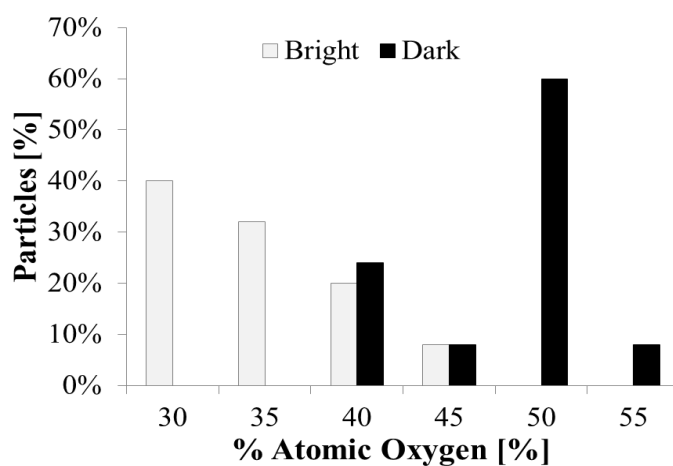


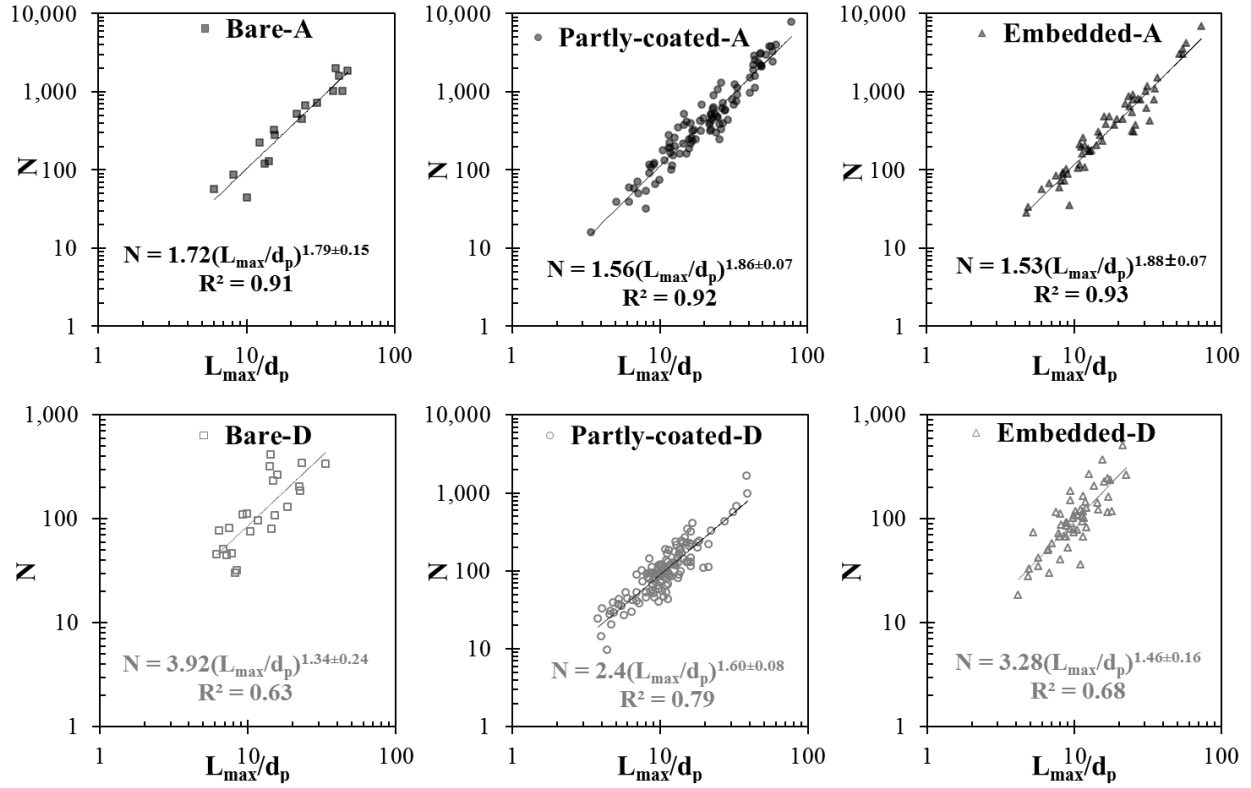
## Supplementary Information



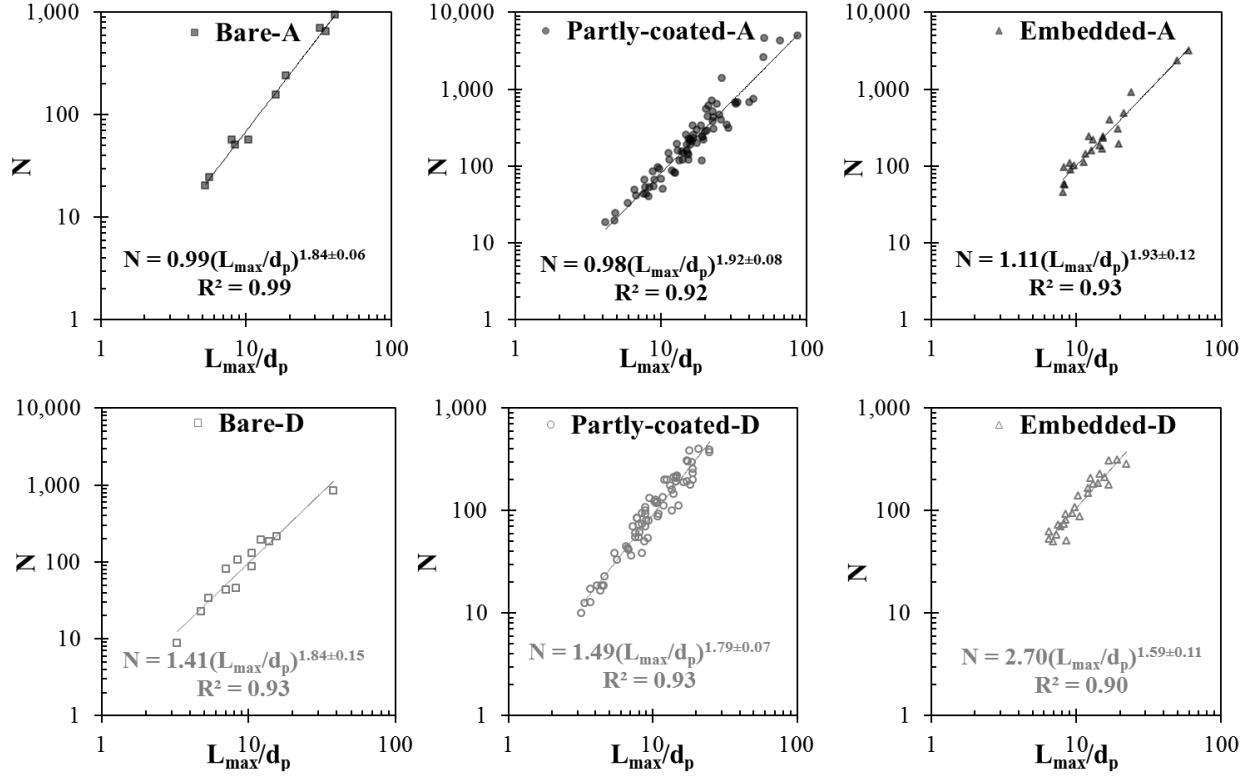
**Supplementary Figure S1:** Distribution of gray scale intensities and grouping of “electronically” dark and bright TBs.



**Supplementary Figure S2:** Atomic oxygen content in bright and dark TBs.



**Supplementary Figure S3:** Fractal dimension of classified soot particles for three categories of soot for sample-1. Here “A” represents ambient and “D” represents denuded samples. The number of particles used for the calculation were 17, 101 and 58 for Bare-A, Partly-coated-A and Embedded-A, respectively; and 23, 130 and 55 for Bare-D, Partly-coated-D and Embedded-D, respectively. Standard errors in the fractal dimension of each category were calculated from the uncertainty in the mean- square fit considering the uncertainty in  $N$  and  $d_p$ . Note that the spread in the points for the denuded sample are higher than for the ambient sample; this might be due to the variable denuding temperature. Higher errors in the bare soot samples are due to the small number of data points available, as the percentage of bare soot in the samples are quite small. The highest fractal dimension is found for embedded-soot particles followed by partly-coated and bare soot for ambient samples; however, differences are not statistically significant ( $p > 0.05$ , paired Student’s t-test). For denuded samples, the highest fractal dimension was found for partly-coated particles. This trend might be expected, as embedded soot is the most coated while bare soot does not have any substantial coating. The differences between the fractal dimension for ambient and denuded particles  $\Delta D_f \equiv (D_{f\text{-ambient}} - D_{f\text{-denuded}})$  are  $\Delta D_{f[\text{Bare}]} = 0.45 \pm 0.28$ ,  $\Delta D_{f[\text{partly-coated}]} = 0.26 \pm 0.11$  and  $\Delta D_{f[\text{Embedded}]} = 0.42 \pm 0.17$ . Note that the differences between the fractal dimension for ambient and denuded bare particles  $\Delta D_{f[\text{Bare}]} = 0.45 \pm 0.28$  for sample-1 is probably not sufficiently robust to draw any conclusion as the scatter in the Bare-D data is high.



**Supplementary Figure S4:** Fractal dimension of classified soot particles for three categories for sample-2. The number of particles used for the calculation were 10, 74 and 23 for Bare-A, Partly-coated-A and Embedded-A, respectively; and 13, 69 and 25 for Bare-D, Partly-coated-D and Embedded-D, respectively. Also for sample 2, the highest fractal dimension is found for embedded-soot particles followed by partly-coated and bare soot for ambient samples. For denuded samples the highest fractal dimension was found for bare soot particles. The differences between the fractal dimension for ambient and denuded particles ( $D_{f-ambient} - D_{f-denuded}$ ) are  $\Delta D_{f[Bare]} = 0 \pm 0.16$ ,  $\Delta D_{f[partly-coated]} = 0.13 \pm 0.11$  and  $\Delta D_{f[Embedded]} = 0.34 \pm 0.16$ .

**Supplementary Table S1| Sensitivity analysis of the effect of different input parameters on number of monomers, fractal dimension and prefactor for soot particles.**

			Ambient-1			Denuded-1		
$\delta$	$\alpha$	$k_o$	$D_f$	$k_g$	$N$	$D_f$	$k_g$	$N$
1	1.07	1.18	1.75	2.48	277	1.45	3.74	83
			(0.04)	(1.13)	(502)	(0.06)	(1.15)	(85)
1.5	1.13	1.50	1.85	3.09	498	1.53	5.08	135
			(0.05)	(1.13)	(995)	(0.06)	(1.16)	(155)
1.7	1.145	1.625	1.88	3.66	589	1.56	5.63	164
			(0.04)	(1.14)	(1205)	(0.07)	(1.17)	(189)
	1.09	1.15	1.81	2.37	303	1.46	3.76	85
			(0.04)	(1.13)	(567)	(0.06)	(1.15)	(88)
	1.09	1.0	1.81	2.10	263	1.46	3.20	74
			(0.04)	(1.12)	(493)	(0.06)	(1.16)	(76)

Values of  $D_f$ ,  $k_g$  and  $N$  for different overlap parameters ( $\delta=1$  to 1.7) and for  $\alpha$  and  $k_a$  values most commonly used in literature of 1.09 and 1.15 (or 1.0), respectively. The numbers in parenthesis represent standard errors for  $D_f$  and  $k_g$  and standard deviations for  $N$ .